SSVEO IFA List **Date:02/27/2003**

STS - 78, OV - 102, Columbia (20) **Time:04:04:PM**

Tracking No	Time	Classification	Documentation		Subsystem
MER - 5	**MET:** 00:00:29	Problem	**FIAR**	**IFA** STS-78-V-01	DPS
DPS-01	**GMT:** 172:15:18		**SPR**	**UA**	**Manager:** Rafael Munoz
			IPR 80V-0003	**PR** OEL-2-21-1947	x38359
					Engineer: Dave Tee

Title: GPC 5 I/O Terminate B Discrete Erratic (ORB)

Summary: At 172:15:18:30 G.m.t. (00:00:29:30 MET), the general purpose computer (GPC) 5 input/output (I/O) terminate B discrete began behaving erratically, toggling from high to low six times. The backup flight system (BFS) software was contained in GPC 5. The I/O term B discrete controls GPC I/O on the flight critical buses.

The BFS software was successfully loaded into GPC 2 at approximately 176:20:05 G.m.t. (04:05:16 MET). A dump and compare of the GPC 2 software confirmed a nominal software load. During the same time frame, GPC 5 was initial-program loaded (IPLed) with PASS, loaded with GNC OPS 2 software, and placed in a redundant set with GPC 1 (commanding no strings). The GPC 5 output switch was placed in the terminate position. This configuration was maintained, with no anomalous GPC 5 behavior observed, until 177:21:01 G.m.t. (approximately 25 hours), at which time the GPC 5 output switch was placed in normal. This configuration was maintained until deorbit preparations and no further occurrences of the erratic I/O term B discrete were observed. Troubleshooting steps involving GPC 4 were taken to assist in isolating the failure. The GPC 4 output switch was placed in the backup position at 181:17:07 G.m.t. (09:02:18 MET) to provide insight into a possible failure between the essential bus (ESS) 3AB fuse powering the backup position of the GPC output switches and the output switches themselves. If the GPC 4 I/O term B discrete toggled while this switch was in the backup position, the failure would affect the BFS regardless of which GPC contained the BFS software. No toggles were seen and the GPC 4 output switch was placed in terminate at 184:07:29 G.m.t. (11:16:40 MET). During deorbit preparations at 189:09:19 G.m.t. (16:18:30 MET), the BFS (in GPC 2) registered an error code 41 (illegal engage) similar to the error that was logged during ascent when the BFS was in GPC 5. This incident is coincident with the GPC 4 output switch being taken from terminate to normal, offering an explanation for the error code. The output switches for the GPCs are "break-before-make," and as such, moving the GPC 4 output switch from terminate to normal causes a momentary break in the ESS 3AB power to the backup position of the GPC 2 output switch, in turn causing a transient in the I/O term B for GPC 2. No further occurrences of the erratic I/O term B were seen during the remainder of the mission. Postlanding, GPC 2 software (BFS) was dumped for analysis as a precaution. A similar failure occurred in this same slot on STS-32 (OV-102/flight 9). The backup flight controller (BFC) and the GPC were removed and replaced. The failure was not isolated in ground testing and was closed as an unexplained anomaly with a most probable cause of the BFC. Troubleshooting began on Tuesday, July 9. The state of the I/O terminate B discrete was monitored for approximately 80 hours, with no recurrence of the anomaly. Wire wiggle and pin

push tests were performed with no recurrence of the anomaly. A breakout box was installed at the BFC and the select, select off, and the terminate B true and complement signals were verified to be nominal. The BFC delay timer was measured and found to be within specification, suggesting that the circuit upstream of the BFC did not play into the failure. A HiPOT of the I/O terminate B true and complement wires showed 0.2 milliamps of leakage at 800 volts, indicating a potential short between the wires. Flexing the harness caused the reading to fluctuate. Although the reading was within OMRS limits (0.5 milliamps), the wire runs were removed and sent to the malfunction lab for analysis. The failure analysis found anomalies with the I/O terminate B true and complement wires. At the GPC connector (J5), a broken wire strand was found near the pin 28 (I/O term B complement) contact and the connector grommet was cracked at pins 28 and 27 (I/O term B true). Wire remnants were found in the pin 27 cavity. A short between pin 27 and one of several other adjacent pins would produce the failure signature. Although no conclusive evidence of the failure was found, the decision was made to close the problem as a UA based on the replacement of the suspect wires. No other LRUs were replaced.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 3	**MET:** 00:00:11	Problem	**FIAR**	**IFA** STS-78-V-02	ECLSS
EECOM-01	**GMT:** 172:15:00		**SPR**	**UA**	**Manager:** Nanette Cerna x39045
			IPR 80V-0005	**PR** ECL-2-21-1138	**Engineer:** Charlie Dumis x45120

Title: FES High-Load Duct Temperatures Low During Ascent and High-Load Core Freeze-up During Deorbit Prep (ORB)

Summary: During ascent, the flash evaporator system (FES) high-load duct temperatures were erratic and lower than normal. The inboard duct temperature dropped to approximately 119 ?F by 13 minutes MET (normally the temperature stays above 190 ?F). The heaters were reconfigured from system A only to systems A and B at approximately 13.5 minutes MET and the temperatures eventually recovered. Throughout the occurrence, the evaporator outlet temperatures were stable. No further problems with the FES were noted during ascent. In order to verify the performance of the high load duct system A heater, the heater was powered up at 173:16:14 G.m.t. (01:01:25 MET) and temperatures were monitored for approximately 2 hours and 45 minutes. A nominal temperature signature was observed.

During deorbit preparations at approximately 189:10:04 G.m.t. (16:19:15 MET), the FES shut down after almost an hour and a half of operation in the full-up mode on the primary B controller. The high-load core was flushed, and the data indicated ice exiting through the high-load duct. A flush was also performed on the topping core followed by a second high-load core flush, but no additional ice was noted. The remainder of deorbit prep and entry was performed using the primary A controller with no further anomalies. KSC troubleshooting is complete. This troubleshooting consisted of internal and external visual-inspections of the high-load core, as well as leak and flow-rate testing of the system A and B high-load spray valves. No anomalies were noted in the visual inspections or spray valve leak tests. Initial flowrate testing of the high-load system A spray valve resulted in a flowrate of 141 lb/hr. Following several backflushes of the valve, the flowrate decreased to 101 lb/hr. Since the change in flowrate is unexplainable, the decision was made to remove and replace the valve. The system B high-load spray valve was removed and replaced as well. Additional flushing of the A feedwater system was performed and the accumulator was flushed on the bench. The B feedwater system/accumulator was flushed as well. The high-

load spray valves are at the vendor for failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 7	**MET:** 02:01:01	Problem	**FIAR**	**IFA** STS-78-V-03	ECLSS
EECOM-03	**GMT:** 174:15:50		**SPR**	**UA**	**Manager:** Nanette Cerna x39045
			IPR 80V-0007	**PR**	**Engineer:** Charlie Dumis x45120

Title: FES Topping Core Freeze-ups (ORB)

Summary: At approximately 174:15:50 G.m.t. (02:01:01 MET), while in the topping mode and on the primary A controller, the flash evaporator system (FES) shut down. A restart attempt on the A controller was unsuccessful, and was followed by an unsuccessful restart attempt on the B controller. Data from the shutdown and subsequent unsuccessful restarts indicated icing in the FES core. A FES core-flush initiated at 174:17:12 G.m.t. (02:02:23 MET) successfully removed the ice from the core and nominal operation was restored on the B controller. Although the cause of the FES freeze-up was unknown, a contributing factor was believed to have been operating the FES in the topping mode near its maximum heat load capability. Therefore, to reduce the heat load to the FES, the port radiator was deployed at 174:18:13 G.m.t. (02:03:24 MET). The deployed radiator provided additional cooling capacity for the active thermal control system, thereby minimizing the chance of additional FES freeze-ups.

To obtain additional data, a FES water dump was requested (mission chit 13) on the B controller, and if successful, the A controller. The water dump on the B controller was initiated at approximately 180:08:19 G.m.t. (07:17:30 MET) and the FES shut down due to icing at approximately 180:10:08 G.m.t. (07:19:19 MET). The core-flush procedure was performed and no additional FES water dumps were attempted. KSC troubleshooting is complete. This troubleshooting consisted of internal and external visual-inspections of the topping core, as well as leak and flowrate testing of the system A and B topping spray valves. No anomalies were noted in the visual inspections or spray valve leak tests. Initial flowrate testing of the topping system A spray valve resulted in a flowrate of 141 lb/hr. Following several backflushes of the valve, the flowrate remained the same. The particulate count from the flushes indicate that the topping system is quite clean. Flowrate testing and backflushing was also performed on the B feedwater system and the results were nominal. It was believed that the freon coolant loop (FCL) 1 flowrate (~3025 lb/hr), which is the highest flowrate of any FCL in the fleet, or the FCL 1 and 2 flowrate imbalance (~250 lb/hr), may have played a role in the freeze-ups of the topping evaporator. As a result, FES testing was performed at JSC to demonstrate that theory. During this testing, under similar as well as more severe conditions than those seen during STS-78, the FES performed nominally. However, the decision was made to adjust the FCL 1 flowrate to within +50/-150 lb/hr of the FCL 2 flowrate. No further testing or LRU replacement is planned prior to STS-80.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 10	**MET:** 03:21:11	Problem	**FIAR**	**IFA** STS-78-V-04	PRSD
EGIL-01	**GMT:** 176:12:00		**SPR**	**UA**	**Manager:** Howard Wagner x39048
			IPR 80V-0004	**PR**	**Engineer:** Ray Gonzales x45403

Title: PRSD H2 Tank 4 Heater B Failure (ORB)

Summary: At approximately 176:12:00 G.m.t. (03:21:11 MET), while the fuel cell H2 was being supplied by tanks 4 and 5, H2 tanks 4 and 5 quantities began diverging, with the tank 4 quantity decreasing at a slower rate than the tank 5 quantity. The heaters on both tanks are controlled by a common controller and are therefore commanded on simultaneously. On-orbit troubleshooting, during which tanks 4 and 5 were operated for several hours on the A heaters only, followed by the B heaters only, confirmed that the tank 4 B heater had failed. The failure did not significantly impact H2 tank use, and tanks 4 and 5 were run to depletion using the A heaters only.

During STS-75, a similar failure occurred (reference IFA STS-75-V-04). Failure of the tank 4 A heater was confirmed, and the fuse for that heater was removed and replaced during turnaround. The failure analysis determined that the fuse failed mechanically as a result of cyclic heating, not excessive current. The heater was still failed during detanking operations at KSC. The heater controller was accessed and the fuse was removed. X-rays indicate that the fuse was mechanically failed. Failure analysis found evidence that the fuse had been weakened as a result of cyclic thermal stresses caused by heater power cycles.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 8	**MET:** 00:50:00	Problem	**FIAR**	**IFA** STS-78-V-05	APU
MMACS-02	**GMT:** 172:15:39		**SPR**	**UA**	**Manager:** Brad Irlbeck x38617
			IPR	**PR** APU-2-A0028	**Engineer:** Walter Scott

Title: APU 1 Fuel Pump Inlet Pressure Decay (ORB)

Summary: As expected, the APU 1 fuel pump inlet pressure (V46P0110A) decayed post-ascent following closure of the fuel isolation valve (FIV) due to fuel pump carbon seal leakage into the seal cavity drain. This is the same APU that was flown in this position on the previous flight of OV-102 (STS-75), when a similar decay was observed. The fuel inlet pressure dropped to approximately 40 psia indicated (24 psia corrected) which was just above the indicated seal cavity drain line pressure of 22 to 23 psia (MSIDs V46P0190A and V46P0191A). The pressure decayed at a higher rate this mission than during STS-75, which indicates the leak may be worsening (the

inlet pressure did not crack the FIV relief valve as is typically seen). Since opening the FIV with a fuel pump inlet pressure above 15 psia was not a concern, and dynamic seal leakage had not been noted, the leak posed no flight impact. The fuel pump inlet and seal cavity drain pressures were stable throughout the mission.

The APU 1 FIV opening was delayed from the normal deorbit Tig-45 minutes to just prior to APU 1 start at EI-13. This was done to minimize the time that the leaking fuel pump seal was subjected to full tank pressure and the subsequent static leakage. APU 1 performance was nominal during its entry run. The APU 1 fuel pump inlet pressure dropped to 43 psia indicated (27 psia corrected) post landing. It had dropped to 49 psia indicated within 26 minutes after landing. Again the data suggests that the leak has increased since STS-75. APU 1 was removed and replaced based on the evidence of increased leakage and the probable failure of a speed sensor (MER-15). The APU 1 catch bottle was drained of 365 cc of hydrazine. The removed APU has been sent to the vendor for failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 15	**MET:** 16:21:02	Problem	**FIAR**	**IFA** STS-78-V-06	APU
MMACS-03	**GMT:** 189:11:51		**SPR**	**UA**	**Manager:** Brad Irlbeck
			IPR 80V-0011	**PR** APU-2-21-0463	x38617
					Engineer: Walter Scott

Title: APU 1 Turbine Speed Sensor Erratic (ORB)

Summary: At 189:11:51 G.m.t. (16:21:02 MET), when APU 1 was started for its entry run, the downlinked turbine speed sensor [magnetic pickup unit (MPU) 3] was initially failed off, became erratic for approximately four minutes, and then worked continuously for the remainder of the APU run. MPU 3 is one of three turbine speed sensors per APU and the only one that is downlinked. Its erratic performance did not affect APU 1 operation. The most probable cause of the failure is an open circuit in the MPU 3 coil wire. This failure mode has been seen on previously, some of which were intermittent. However, this is the first in-flight occurrence.

KSC performed troubleshooting on the vehicle prior to the removal and replacement of APU 1 (reference MER-08). The initial troubleshooting consisted of an auto BITE check using the APU controller. The test failed indicating a continuity failure. An additional APU controller checkout isolated the problem to the MPU 3 circuit. The APU has been removed and replaced.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 14	**MET:** 16:19:36	Problem	**FIAR**	**IFA** STS-78-V-07	GN&C
GNC-01	**GMT:** 189:10:25		**SPR**	**UA**	**Manager:** Vincent Levy
			IPR 80V-0010	**PR** V070-2-21-0363	x30874

Engineer: Vester Purkey

Title: Rudder Channel 3 Position Feedback Erratic (ORB)

Summary: During deorbit preparations at 189:10:25 G.m.t. (16:19:36 MET), the rudder channel 3 position feedback became erratic. Prior to entry interface (EI), the rudder is positioned at +5 degrees so that a failure of this type can be detected. The problem was also seen in the servo-valve current as well as the secondary differential pressure measurements following APU 2 start. Prior to EI, the measurement appeared to heal but was still very noisy. After EI, when the rudder is positioned to 0 degrees, the decision was made to manually bypass rudder channel 3. The crew executed the bypass command at 189:12:02 G.m.t. (16:21:13 MET), which left the rudder operating on channels 1, 2, and 4 and was thus tolerant of a second failure. During the latter part of entry when the rudder was used for steering, the rudder channel 3 position measurement healed and operated properly. This problem is believed to be caused by a continuity problem between the position transducer in the rudder/speedbrake power drive unit (PDU) and aerosurface servoamplifier assembly 3 (ASA 3) in avionics bay 6.

KSC troubleshooting consisted of inspection and testing of the cable between ASA 3 and the PDU. The testing included cable/connector flexing, a continuity test, and a HiPOT test. The anomaly did not recur. The cable from the PDU to ASA 3 was removed and replaced. Also, the decision was made to remove and replace ASA 3. The cable and the ASA have been sent to the NSLD for failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 16	**MET:** 16:21:42	Problem	**FIAR**	**IFA** STS-78-V-08	HYD
MMACS-04	**GMT:** 189:12:31		**SPR**	**UA**	**Manager:** Don Allison
			IPR 80V-0020	**PR**	x39033
					Engineer: Jim Wiltz
					x39009

Title: WSB 1 Ready Indication Unexplained Toggles (ORB)

Summary: At 189:12:31 G.m.t. (16:21:42 MET), several minutes prior to landing, toggling of the WSB 1 ready indication was indicated. Toggling of this indication is not unusual and is typically caused by the WSB hydraulic fluid bypass valve transitioning between the heat exchanger and bypass positions. However, during STS-78, bypass valve movement was not indicated. None of the other parameters that can cause a ready indication to change state (controller enabled, steam vent temperature, or GN2 shut-off valve position) would explain the toggles that were indicated.

Initial troubleshooting exonerated the WSB bypass valve and controller. Further troubleshooting checked the data path from the WSB controller back to the OA1 MDM in avionics bay 4 to determine where the bypass valve position indication was being lost. The problem was determined to be a caused by a recessed pin at a connector between the controller and the OA1 MDM.